the Yué-tchi, and a part of them, under Maues, founded a kingdom in the Panjab, where they quickly appropriated Hellenic culture.

The Sakas appear to have been mesaticephalic; the height of the head was rather low, they had straight eyes, a well-formed nose, straight, projecting chin. Ujfalvy remarks that they were not true Scythians, as the Aryan element was outweighed in them by another strain. They are nearer to the typical Parthians, but they are not Tatars.

For two thousand years they have persisted, and in the Balti of to-day Ujfalvy recognises the direct descendants of the Sacæ who, about 90 B.C., invaded India from the north over the Karakoram passes, since, in their physical features, the Balti strikingly resemble the effigies on the rock carvings or on the coins of the kings of the Sacæ. The Pamir countries of the Chugnan and Sirikol still retain Sacian linguistic traces.

The Chinese annalists inform us that the Yué-tchi were located in eastern Turkestan, south of the Celestial Mountains, but being invaded by the Hiung-nu in 201 and 165 B.C., they fled to the west and spread over Sogdiana and Bactria, and dispossessed the Ta-hia (Tadjiks). The annalist thus speaks of the inhabitants of Sogdiana: "Sunken eyes, prominent nose and bushy beard, they excel in trade," just like the living Tadjiks. The primitively nomadic Yué-tchi became sedentary and prosperous in this fertile country. In B.C. 25 Kieu-tsieu, or Kudschula, whom the Greeks called Kadphises, the prince of the Kuei-schuang (Kushan), one of the five tribes of the Yué-tchi, conquered the four other tribes, and, crossing the Hindu Kush, invaded Kophen (Ki-pin of the *Chinese Annals*), the country of the Asascides, and took possession of Kabul. His son Kadaphes conquered most of Northern India, and this empire lasted till towards the commencement of the fifth century of our era. The *Chinese Annals* tell us that Ki-to-lo (Kidara of the coins) chief of the Great Kushans, yielded before the incursions of the Ephthalites, crossed the Paropamisus and settled at Gandhara, in the Valley of Kabul. Towards 475 A.D. the Ephthalites, or White Huns, conquered Gandhara, forcing the Kushans to retire in the Chitral and up to Kashmir. After the defeat of Mihirakula, the last Huna king, the Kushans preserved their power in these regions till the ninth century of our era.

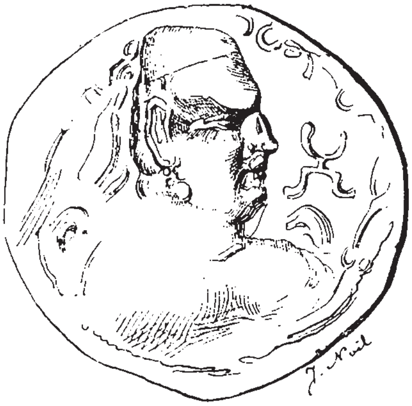

FIG. 2.—Coin of Jayatu Mihirakula (Mo-hi-lo-kiu-lo of the *Chinese Annals*), last King of the Hûnas; 515-544 A.D.

The Kushans appear to have been a brachycephalic folk with a normal head, high forehead, straight eyes, powerful Semitic nose, full mouth, with a somewhat Semitic cast of countenance, but not in the least Mongolian; there was a full beard. These, according to Ujfalvy, are Tatars and not Mongols, the true Scythians of Hippocrates; with Keane ("Man, Past and Present," p. 322) we may call them a Turki people.

They were a gifted and powerful people, and, in consequence of their high political endowments and their adaptability, they played a predominant part alike in Bactria and North-west India, and to a large extent contributed to the formation of the present racial type north and south of the Hindu Kush, and especially so among the Dards of the Himalayan Valleys.

The Hoa or Ye-tha, originally a small people located to the north of the Great Wall of China, were hunted from their territory by the Yuan-Yuan (or Avars?) and fled to the west, and eventually invaded Transoxiana (425 A.D.) and founded a great empire as far as North-west India. The invasion of Europe by Attila (430 A.D.) and that of the Caucasus by the Kidarite Huns were the result of the same pressure of the Yuan-Yuan.

The Hoa sovereigns had the family name of Yé-ta-i-li-to (Ephthalites) which became the name of the dynasty; this was abridged to Ye-tha. Unlike the Yué-tchi they remained nomads, and, as the Chinese annalists inform us, they practised polyandry. Their empire lasted till 557 A.D., when the Tu-kiu (Turks), profiting by the troubles that had fallen on the Hoa or Huna, seized the government. After their defeat, the Ephthalites did not disappear from Turkestan but retired to the east, while another portion mixed with Kushans south of the Oxus.

The Chinese annalists give various interesting accounts of this people. The Hoa migrated with their flocks and did not live in towns. The women took a good standing; brothers took a wife in common, and the women wore a horn on their headdress for each husband that they had. The people were cruel, valiant and bellicose, and had strict laws.

According to the coins the three kings of the Hûnas (the White Huns or Ephthalites of India) were absolutely hairless, the face has a savage expression, the eyes appear somewhat oblique, the nose is large, jaw powerful, neck fleshy, ears immense and in two of the kings recall the legendary pointed ears of Attila. The occipital region of the head is deficient, the vertex being produced into a truncated cone; this remarkable shape must have been the result of artificial deformation, which greatly exaggerated the natural brachycephaly. They are still Tatars, but approach the Mongolian type.

Polyandry was one of the most characteristic traits of the Hoa, and it still persists in the regions which formerly belonged to their empire. The employment of the horned headdress, which was formerly associated with polyandric practices, still exists among the inhabitants of Kafiristan.

There are still many problems awaiting solution among the intricacies of Asiatic ethnology, and it may be that some of the foregoing conclusions will require emendation, but there can be little doubt that the brilliant researches of C. de Ujfalvy have paved the way to a clearer comprehension of the ethnic affinities of various ancient historical peoples, and his papers in *l'Anthropologie*, Tomes IX. (1898) and XI. (1900), and in the *Archiv für Anthropologie*, Bd. XXVI. (1899), are full of references to the labours of his distinguished fellow-workers, Drouin, Percy Gardner, de Lapouge, Maspero, Rapson, Specht, Stein and others.

ALFRED C. HADDON.

THE CURRENTS IN THE GULF OF ST. LAWRENCE.

THE result of investigation of the currents in the Gulf of St. Lawrence, by the Survey of Tides and Currents, has been issued recently in the form of a pamphlet by the Department of Marine and Fisheries, Canada. These investigations were carried on by Mr. W. Bell Dawson, in charge of this Survey, and were made during the summer months of 1894, 1895 and 1896; and they are supplemented by information collected personally by him from captains of vessels, fishermen and others having a long experience in the Gulf. The examination of the currents was made chiefly along the lines of the leading steamship routes which traverse the Gulf. It thus comprises the more open area of the Gulf rather than the estuaries and straits in which stronger tidal streams occur locally.

In the investigations a steamer was employed. It was anchored in positions carefully selected for the purpose in view. These were in all depths, up to 250 fathoms. The steamer thus served as a fixed point from which to observe the behaviour of the current. The observations of the current and of the force and direction of the wind were continuous day and night. Both the surface current and under-currents were investigated, current-meters, registering electrically, being chiefly used for the purpose. Temperatures and densities were also obtained at all depths, to 200 fathoms; and these indications were found of much assistance in tracing the movement of the water. For fuller descriptions of the methods and appliances employed, some of which were specially adapted to the conditions in the Gulf, the reports of progress issued from year to year by this survey must be referred to.

With regard to the general circulation in the Gulf area, the investigations point to its being, broadly speaking, a movement of rotation in a left-handed direction. It has been proved that there is no great influx of cold water into the Gulf area through Belle Isle Strait, as was formerly supposed. On the contrary, the chief interchange of water between the Gulf and the ocean is at Cabot Strait, the wider entrance to the Gulf south of Newfoundland.

We cannot enlarge further on these interesting results, as the information as now published is in as concise a form as it can be put. We desire, rather, to draw attention to some points which the investigations themselves emphasise, and which are of general application elsewhere in similar work.

The most important of these is the relation of the under-currents to the current on the surface. These were examined everywhere, to a depth of 30 fathoms at least, as this depth extends almost uninterruptedly over the whole Gulf area. It may be thought, at first sight, that the direction of the under-current has no bearing upon the movement of the water as it affects navigation. In such a region as the Gulf of St. Lawrence, however, the currents in the summer months are all very moderate in their speed, usually ranging from half a knot to one knot per hour; and their direction on the surface is accordingly much influenced by the wind. It was found in these circumstances that the movement of the under-current at 20 or 30 fathoms often showed more definite characteristics; as, for example, a tendency to make constantly in some one direction, or to vary with the tide. The wind is thus a disturbing element; and the under-current, being more in accordance with the normal conditions of the locality, will come up to the surface as soon as the disturbing influences which have been acting on the surface of the water cease to operate.

It may be unfortunate, from the point of view of the navigator, that it is the surface of the water to a depth of 5 or 10 fathoms which is so readily and so frequently disturbed; but, on the other hand, it is clear that it is essential to make a careful investigation of the under-current in order to understand the surface current itself. The study of the under-current is also necessary, if any hope is entertained of arriving at the general circulation in the Gulf or the true relation of its currents to the causes which influence them.

When a period of some length is considered as a whole, and the under-current is also taken into account, it becomes possible to trace the general circulation of the water; which depends upon a greater movement in some dominant direction rather than in other directions, when long averages are taken.

The primary tendency in the surface current is thus to follow the direction which the general circulation has in the locality in question; but this tendency is disturbed and often overcome by the influence of the tide and wind. The tidal influence shows itself chiefly as a veer in the direction of the current, which is either through a limited range or completely around the compass; and it is also probable that the tides themselves are irregular in some localities, owing to interference. When the wind remains in one quarter and has any considerable strength, the drift which it gives to the surface water soon extends to a depth of five fathoms or more, and its influence thus makes itself felt throughout the thickness of the surface layer which affects shipping. As a rule these influences are all acting at the same time; and it is their combined effect which gives rise to the actual behaviour of the surface current.

A knowledge of the general circulation is also important to mariners, as it includes all the more constant currents, and it shows the direction which the surface current tends to take when undisturbed. Although there are few instances of currents in the Gulf area which run steadily enough to be termed constant, we have yet found it possible, from continuous observation or long experience, to arrive at a dominant direction for each locality; or the direction in which the current runs more frequently, and in which, therefore, the water makes on the whole.

With regard, also, to the drift of ice as an indication of the set of the current, a superficial view may readily be taken; but it is here pointed out that to infer correctly the set of the current it is necessary to distinguish between the different kinds of ice met with and their relation to the movement of the surface of the water and to the under-current, respectively.

This is illustrated by the character of the ice met with in the Gulf of St. Lawrence, which is of three kinds:—(1) Berg ice, or true icebergs, found in the vicinity of the straits opening into the ocean. (2) Flat or pan ice, forming fields or in broken pieces, usually not more than 6 feet in thickness, but sometimes as thick as 10 feet. This often jams or shoves along the shore or between islands, and may form masses 20 feet or more in thickness, but it can never be mistaken for berg ice. (3) River ice, from the St. Lawrence River and its estuary. This is also flat ice, but it can be readily distinguished by its appearance from the Gulf ice.

The berg ice, from its great depth in the water, will evidently move with the under-current; and it will not be appreciably affected by the wind. These bergs do not necessarily indicate the direction of the current as affecting shipping, except when the surface current has also the same direction. They show in reality the average direction the current has between the surface and the depth of their draught. This draught is limited to about 30 fathoms by the depth of the Belle Isle Strait. They are thus of much value as an indication of the general movement or circulation of the water.

The relation of the flat ice to the wind and current requires some little consideration. It is, of course, just as true of this ice as of the berg ice, that the greater part is under water; but, as it is almost always in broken pieces, more or less piled and with upturned edges, the wind has a much greater hold upon it, in proportion to its total weight, than on the berg ice. Even when this is allowed for, its depth in the water still gives the current a greater hold upon it than the wind has. For example, if such ice is drifting with a current in a given direction, and the wind is blowing across that direction at right angles, the ice will seldom be set more than two points, or three at the most, off the true direction of the current. When the ice becomes soggy or water-soaked and loses its edges, as it does later in the spring, it will set still more correctly with the current.

When the surface current itself is moving in the direction of long-continued or prevalent winds, as it often does in the Gulf, the flat ice naturally follows the same direction too. Also, in regions where the current is tidal, and the ice in calm weather would drift as far in the one direction with the flood tide as in the other direction with the ebb, the direction in which it makes, on the whole, will depend upon the wind. It is probably for these reasons that it is so often said that the ice drifts with the wind; although this merely expresses the fact, without distinguishing between the relative influence of the wind and the current upon it.

There is also a direct effect which the ice has upon the strength of the current in regions where the direction of the surface drift is under the influence of the wind. The broken and upturned edges of the ice give the wind a much greater hold upon the water than it otherwise would have. Hence during long continued winds the speed of the current is appreciably greater than if the ice were not present. This is undoubtedly the explanation of the common belief which is expressed by saying that "the ice makes its own current." It may be well to recall that the weight of the ice itself is the same as the water which it displaces; and, therefore, the wind has no greater mass to set in motion in producing a surface current than if the ice were to melt and refill the hollow which it makes in the water; yet the presence of the ice gives the wind a better hold than it would have upon the surface of open water free from ice.

There is one condition of the ice which may prevent it from showing correctly the movement of the water. When it is set against an island or headland and packed together for a long distance out, with open water beyond, it may circle round as on a pivot. The outer edge of the pack may thus make a long sweep very different in its path from the true set of the current; and its movements also become irregular, as vessels caught in such ice which are near together in the evening may be ten or fifteen miles apart in the morning.

The influence of rivers flowing into such a land-locked area as the Gulf of St. Lawrence is also discussed, with approximate measures of volume which show how small the volume of even such a river as the St. Lawrence is, relatively to the water in motion in a costal current, which is more nearly comparable with an ocean current.

The probable balance of flow between the Gulf and the ocean is also explained, but measurements of volume of even an approximate kind are wanting to give precision to the results. The importance of such investigations with regard to the movements of fish, which must be influenced by the temperature of density of the water, is also emphasised, in view of the large annual value of the Canadian fisheries.

The further investigation of the currents has been discontinued since 1896 for reasons of economy; but the tides themselves are receiving careful attention, and already trustworthy tide-tables are issued by the Survey for the more important Atlantic harbours, as well as for the Pacific coast of Canada. The tides are complicated by a great variation in range, and the observations secured will serve also as a basis for future investigation of the currents, many of the strongest of them being tidal in their nature.

THE ABSORPTION SPECTRA OF SALINE SOLUTIONS.

IN the *Scientific Transactions* of the Royal Dublin Society (vol. vii. series ii. pp. 253-312), Prof. W. N. Hartley gives the results of a long series of experimental investigations which he has undertaken to determine the action of heat on the absorption spectra and chemical constitution of saline solutions. After reviewing previous researches by Schœnbein, von Babo, Schiff, Gladstone, Bunsen, Melde, Burger, Vogel, Landauer, Morton, Bolton and Russell, the author gives a description of his mode of experimenting. Wedge-shaped cells containing the liquids under examination were heated in an air-bath with glass sides. The sources of light used were sunlight and an argand burner fed with oxygen.

Then the absorption spectra of solutions of the salts of nickel, copper, cobalt, chromium, uranium, didymium, and various permanganates are described, with details of the measurements, accompanied by drawings from, or reproductions of, the photographed spectra. Much of the discussion is directed to the bearing of the spectral evidence as to the constitution of the solutions, and the following conclusions indicate the results arrived at:—

(1) The absorption spectra of different salts of the same metal, whether solid or in solution, are not identical, even when the spectrum is a marked characteristic of the metal.

(2) When a definite crystalline hydrate dissolves in a solvent which is not water, and is not a dehydrating agent, the molecule of the salt remains intact.

(3) In any series of salts which are anhydrous, and which do not form well-defined crystalline hydrates, the action of heat up to the temperature of 100° C. does not cause any further alteration in their absorption spectra beyond that which is usual with substances which undergo no chemical change by such rise of temperature. The change is usually an increase in the intensity of the absorption, or a slight widening of the absorption bands.

(4) As a rule the crystallised metallic salts, in which water is an integral part of the molecule, dissolve in water at ordinary temperatures without dissociation of the molecule.

(5) Crystallised hydrated salts, dissolved in a minimum of water at 20° C., undergo dissociation by rise of temperature. The extent of the dissociation may proceed as far as complete dehydration of the compound, so that more or less of the anhydrous salt may be formed in the solution.

(6) The most stable compound which can exist in a saturated solution at 16° or 20° C. is not always of the same composition as the crystalline solid at the same temperature, since the solid may undergo partial dissociation from its water of crystallisation when the molecule enters into solution.

(7) Saturated solutions of hygroscopic and deliquescent salts combine with water when diluted to constitute molecules of more complex hydrated compounds in solution.

(8) When a saturated solution of a coloured salt undergoes a great change of colour upon dilution, or any remarkable change in its absorption spectrum due to the same cause, the dilution is always accompanied by considerable evolution of heat.

CONFERENCE OF SCIENCE MASTERS IN PUBLIC SCHOOLS.

WHILE carrying out the important work of spreading scientific instruction in this country, our educationists should make themselves quite sure that the teaching already inaugurated is what it claims to be. Care must be exercised in order that a training in habits of exactness and observation is imparted, as well as an appreciation of the principles of science quite apart from a mere knowledge of facts. By intelligent practical work upon the part of the individual scholar this alone can be attained, and under present circumstances such exercise is difficult to successfully organise in schools.

Expensive laboratories and able masters are of no avail if the necessary conditions be not introduced. The scientific staffs of our large public schools are fully aware of their responsibility to the nation, and what is lacking to enable them to fulfil it. It might, therefore, be thought that they would have been the very first to advocate the necessary changes, but their position, it will be seen, is such a peculiar one that, without strong general feeling behind them, their trouble would be all thrown away.

With the dawn of the new century, however, and in view of the present agitation for an improved system of scientific education, the public school science masters have combined all their energies for the attainment of that end. On January 19, therefore, a conference was held at the rooms of the University of London, and was attended by a thoroughly representative body of men. Sir Henry Roscoe, Vice-Chancellor of the University, and a member of the governing body of Eton College, occupied the chair, and explained the importance of the action taken.

Among the papers read, that by Mr. Oswald H. Latter, of Charterhouse, contained perhaps the most general observations. "Science teaching," he told us, "was first introduced into our public schools as a sop to a growing public opinion, and with a desire to impart a gentlemanly acquaintance with scientific matters. The broad-minded persons who ventured on this new departure imagined, unfortunately, that the admirable mediæval methods of classical and mathematical teaching were equally well suited to the new comer, who, however, had to be content with a very small portion of the temporal possessions of its elder bretheren." Mr. Latter then urged the necessity of a scientific education for future legislators, and our commercial and professional men, and from a national point of view. Form teaching would do much, he considered, to remove the incubus of ignorance and apathy in the coming generation, the following being his recommendations with regard to it:—

(1) Science should be raised to the dignity of a "form subject," and no longer be regarded as a more or less negligeable extra. It should enter for at least one hour into the ordinary work of every day, and claim, at any rate, some portion of the time devoted to preparation. There must be some lopping of the old branches of education if good fruit is to be borne by the engrafted scion.

(2) A classification according to proficiency in science throughout the school.

(3) At least half, and with lower forms more than half, of the allotted hours should be devoted to systematic laboratory work in the elements of physics and chemistry.

(4) The teaching should be continued to the sixth forms instead of being deliberately withheld from them as is so often the case, a distinction which at once narrows the intellectual horizon of the ablest boys in the school, and degrades the subject in the eyes of the remainder.

Mr. E. E. Ashford, of Harrow, would with very good reason teach some physics before chemistry, and, if possible, elementary biology before either, for, he said, let us first use the facts a boy knows to teach the methods of science. All boys, he continued, are acquainted with many bits of natural history, and its general laws were more easily appreciated than the more exact ones of the other sciences. The paper by Mr. Ashford concluded with the following resolution, which found favour with the meeting, viz., that "it is essential that every boy before leaving school should go through a course of practical measurement and experiment involving no previous theoretical knowledge."

Prof. Armstrong, who was present, true to his tenets that academic words should not be used in schools, suggested nature-study in place of biology, but the terms were not recognised as synonymous by several speakers, and so he was somewhat misunderstood. Mr. A. Vassall, in describing the work at Harrow, recommended that the biological lessons should form a continuous course, and it must be remembered that the boys (over fourteen and under sixteen years of age) he teaches are not tiny children for whom unconnected object-lessons are best adapted. The list of lessons given to the conference well illustrated Mr. Vassall's plea for the "judicious skipping" of subjects not quite suitable for introductory work. Mr. Cumming, of Rugby, used, he said, to teach all his boys botany; he owned, however, that he had no qualifications but a love of the subject, and it is not surprising that the other sciences he has since substituted have succeeded better.

Mr. W. D. Eggar, of Eton, pointed out that, owing to external pressure, many public schools had started elementary